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TYPHUS FEVER ON THE SAN JUAN INDIAN RESERVATION, 1920 AND 1921.

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During the latter months of 1920 and the first half of 1921, 63 cases of typhus fever with 27 deaths occurred on the San Juan Indian Reservation.

The Reservation lies in New Mexico, Arizona, and Utah, and joins Colorado; it comprises 5,884 square miles. The region is for the most part a semidesert, which, however, supports a scanty growth of grass sufficient to maintain sheep. The scarcity of available water is largely accountable for the backward and impoverished condition of the native population, of whom there are estimated to be about 7,000, slightly more than one person per square mile. With the exception of a few Government employees and traders, the inhabitants are Navajo Indians of pure blood.

HABITS OF LIFE.

The Navajo is nomadic in his habits and never lives in villages. These characteristics are imposed upon him by the necessity of supplying his sheep with fresh pasture and water and of keeping them apart from his neighbors' flocks. His abode, or "hogan," is a primitive structure, ranging from a mere sun shelter of cedar boughs in summer to a log building covered with earth for winter use. The hogan is usually crowded, filthy, and unhygienic, since the Indians lack knowledge of even the most primitive rules of sanitation. Owing to the scarcity of water for domestic purposes, bathing is uncommon and quite unknown to many. Left to themselves, the Indians of the San Juan Reservation are 90 to 100 per cent infested with vermin, usually both head and body lice being found.

THE EPIDEMIC.

Origin of epidemic.—The origin and manner of introduction of typhus fever upon the reservation in 1920 will probably never be definitely known. The region, however, situated as it is between Mexico and the mining regions of Utah and Colorado, serves as a pathway for itinerant laborers, and it may be that some of these travelers carried the infection from across the international border, where typhus is endemic. Or some Indian, as occasionally happens, may have traveled beyond the reservation boundary, where the Indians are known to mingle with the lower elements of society, and carried the infection with him upon his return.

Early cases not recognized.—Cases occurring prior to the middle of May, 1921, were variously diagnosed by Indian and missionary physicians as malignant influenza, black measles, typhoid fever.

Diagnosis.—The epidemic was identified as typhus fever in May by Dr. Waller and Dr. Tappan, of the United States Public Health Service. The sudden onset, the characteristic fever, the mottled and petechial eruption appearing on the fifth to seventh day of the disease, the profound stupor, the foul condition of the mouth, the recovery by crisis in many cases, the age distribution of the fatal cases, and the fact that louse destruction controlled the disease, mark the epidemic definitely as one of typhus fever.

Dr. John G. Graffin, the agency physician at Shiprock, N. Mex., and Dr. George H. Davis, the medical missionary at Red Rock, probably died of the disease, each believing, however, that he had influenza.

Chronology and distribution of cases.—The Navajo has no method of recording time which is capable of ready translation into terms of the Gregorian calendar; hence it is difficult to locate the early cases accurately in point of time. Cases which from all information securable seem to have been typhus fever probably occurred as early as the first part of November, 1920. Cases followed at intervals throughout December, 1920, January, February, March, April, May, and June, 1921.

Infection occurred in three main foci, namely, River Agency, Red Rock, and Tosito, situated with reference to each other about as the apices of an equilateral triangle, the distance between the foci being approximately 30–35 miles. (There are no accurate maps of the region.)

Early cases.—The first known case of typhus occurred in the Red Rock district. The patient was a "medicine man," probably 55 years of age. Early in November this man went to Farmington, where he "sang" over a patient, and was absent about one week. Three or four days following his return he was taken ill, and died on December 10, 1920. Before his death his youngest daughter, aged 16, became ill of the disease, and a week or two later his oldest daughter, aged 20, and his oldest son, aged 23, were stricken; later, the second son, aged 21, and the widow were also stricken. A 4-year-old son escaped. The onset in these various cases probably occurred in November, December, and January.

During the illness of the first case above mentioned, the customary "sing" was held. A brother-in-law of the first case and his wife attended and remained throughout the ceremony, probably 15 days. The husband was stricken three days after their return to Shiprock, N. Mex. This was in December. He died January 10, 1921, making two deaths in this month. From this beginning the disease spread to a total of 63 known cases with 27 deaths. Spread from these earlier cases was usually traceable to the agency of the "sings." The last case developed June 13, 1921, and the last death occurred on June 27.

STATISTICAL SUMMARY.

Chronology of cases.—The onsets of the various cases are estimated to have occurred as follows: November, 1; December, 6; January, 8; February, 2; March, 3; April, 21; May, 10; June, 12; total, 63.

Chronology of deaths.—From agency records the deaths occurred as follows: December, 2; January, 4; February, 2; March, 2; April, 2; May, 11; June, 4; total, 27.

Distribution of cases and deaths by ages.

Age period (years).	Cases.	Deaths.	Remarks.
0-4	1	1	This death was of a child 21 days of age. The mother had typhus but recovered. The child probably died as a consequence of typhus rather than of the disease.
5-9	3		
10-14	6		
15-19	7		
20-24	4		
25-29	2		
30-34	4	1	
35-39	4	2	
40-44	8	4	
45-49	6	5	
50-54	11	7	
55-59	3	3	
60-64	3	3	
65-69	1	1	
Total	63	27	

Sex distribution and case fatality.

	Cases.	Deaths.	Per cent of cases dying.
Males	[1] 37	[1] 19	51.4
Females	26	8	30.8
Total	63	27	42.8

[1] Includes 2 white cases.

Distribution by foci of infection.

Locality.	Cases.	Deaths.
Bed Rock	32	10
River Agency	9	5
Tosito	22	12
Total	63	27

THE CAMPAIGN.

Special conditions.—That the disease did not assume greater proportions prior to its recognition is probably due to the fact that the Indian families were well isolated from one another, one to three hogans usually being situated in one locality, often miles to the nearest neighbor, and to the fact that the Navajo, although he does a certain amount of visiting, confines his visits largely to his own clan. Moreover, by the time the epidemic had reached a stage where the disease might be expected to spread rapidly, spring had brought warm weather with its well-known limiting effect upon typhus.

In spite of these favoring circumstances, however, there were many difficulties to be overcome in eradicating the disease. Among these difficulties may be mentioned the following: The almost complete absence upon the reservation of equipment with which to combat vermin; the distance from markets; the scattered and constantly changing location of the Indians' abode, with the attending difficulties of locating cases; the absence of roads; the high percentage of louse infestation among the natives; the scarcity of available water and fuel; the complete ignorance of the natives with reference to the spread of disease; and the natural fear and superstition which they hold toward any new procedure, such as bathing, together with the tendency to conceal cases because of these fears.

On June 24, 1921, owing to problems of interstate quarantine involved, the Office of Indian Affairs, upon recommendation of Dr. R. E. L. Newberne, Chief Medical Supervisor for that office, requested the United States Public Health Service to assume full control of the situation. The close and efficient cooperation of the Office of Indian Affairs and the Chief Medical Supervisor was, however, continued under the new arrangement.

DETAILS OF THE CAMPAIGN.

The writer arrived at the scene of the outbreak on May 31, 1921. He found there Dr. R. E. L. Newberne; Dr. J. S. Perkins, special physician of the Indian Service; and Dr. J. K. Kennedy, agency physician, who had temporarily taken the place made vacant by the death of Dr. Graffin. Dr. Waller and Dr. Tappan had previously established the diagnosis, following which they acted in an advisory capacity.

Prior to my arrival, Dr. Newberne, with the equipment that he could muster, had begun delousing operations at Tosito. The equipment consisted of a few tubs, 300 gallons of distillate (50 per cent coal oil and 50 per cent gasoline), a barrel of vinegar, and one tent. The delousing process consisted of stripping and painting the individuals with distillate, and either dipping the clothing in the same material or boiling it. The vinegar mixed with distillate was used on the heads to assist in loosening nits.

This process was displeasing to many of the Indians, since mild symptoms, such as headaches and dizziness, were not uncommon following the distillate baths. Superficial blisters were also quite common, the result of dressing before the distillate had completely evaporated from the skin or clothing. It is estimated that from 700 to 1,000 Indians were deloused by this process; but the process was superseded by more humane methods just as soon as necessary equipment had been secured.

The possibility of securing portable delousing outfits from the Army was considered; but it was found that the bridges of the region were not heavy enough to support the weight of this equipment. General delousing operations therefore awaited the construction of light equipment. Our attention in the meantime was directed toward educating the natives, and to the delousing, isolation, and treatment of cases.

Education of natives.—Natives invested with police power were employed, whose duty it was to go periodically from hogan to hogan in the district assigned to them, and to report to the medical officers every case of illness, regardless of its nature. All reported cases were then visited by Dr. Newberne or myself with a view of diagnosis.

By means of these native police and through the trading posts, the Indians of the infected areas were summoned to collect at stated times for the purpose of instruction regarding the "New sickness." These meetings were well attended.

Since the natives were incapable of grasping the scientific facts regarding the spread of typhus, they were told that some one had brought in some Mexican lice and that it was these which were making them ill. (This made a proper impression as the Navajo has an ancient hatred for anything Mexican.) Instructions were given in regard to bathing, the frequent use of boiling water for killing lice on clothing, and regarding the use of coal oil. They were instructed to place in the sun each day from sun up to sun set, pelts and the like, which it was felt they could scarcely handle without aid. While we had no opportunity to test the efficacy of this procedure, it was felt that it might have a discouraging effect on vermin and at any rate exercise a wholesome influence on the dirty pelts and blankets used for bedding, especially since at this altitude (6,000 feet), in the clear dry atmosphere of the desert, the sun shines with great intensity at that time of year—June and July. The danger of spreading the disease through the agency of "sings" was explained; but such apparent dread of being deprived of the services of their native healers was expressed that it was decided that medicine men might hold their "sings" over typhus cases provided they go singly and not permit the friends and neighbors to collect. This was upon condition, however, that the singer be free of vermin and go only after the patient, clothing, and bedding had been deloused; and that he be also deloused before leaving the premises or mingling with other households. The medicine men adhered to this plan admirably and none of them developed typhus following its institution; neither did any typhus develop under this plan which could be traced to the "sings".

Delousing of cases.—As soon as a case was found it was deloused at once by bathing in nicotine sulphate 1:1,000 solution. Clothing and bedding were either boiled or treated with nicotine sulphate or distillate. Other members of the family were also deloused, as were the members of any near neighboring hogans. Delousing was repeated at intervals of not more than six days. For lack of time and personnel, delousings following the first were at times intrusted to native attendants.

We were without means of delousing the hogan, and an effort was made to secure Army tents in order that cases and exposures might be removed from the probably vermin-infested hogan into clean tents; but the tents were not available until after the emergency had passed.

Isolation of cases.—Prior to June 1 an emergency isolation hospital was opened at Shiprock, N. Mex., where three Indians suffering from typhus were confined under the immediate care of Dr. J. S. Perkins. The hospitalization of cases was, however, abandoned, owing to the difficulty of transporting the cases and to the fact that the Indians themselves objected to the procedure. Subsequent cases were isolated in their own hogans with a single attendant assigned to look after them, other members of the family finding other quarters.

General delousing.—It was found impossible to purchase suitable equipment in the available markets. Specifications were therefore decided upon, and Dr. Newberne, at Albuquerque, had equipment built and mounted upon a small truck. The outfit consisted essentially of the truck, a 3-horsepower boiler, a 400-gallon tank for bathing water, two steam tanks for sterilizing the clothes, pumps, spray baths, and three tents. General delousing operations were begun July 9.

Delousing procedure.—Prior to going into a district for the purpose of delousing, mounted guards were sent to notify the people that delousing would begin on a certain day, and that they should come and bring their bedding, pelts, quilts, blankets, clothing, etc. One notice usually sufficed; but if any failed to appear, the guards paid a second visit with instructions to bring them in. When the Indians arrived they were instructed by an attendant to deliver their blankets and other articles which would not be injured by steaming, to the steam sterilizers, where they were subjected to live steam for from 25 to 30 minutes. While this steaming was going on, the women took their pelts to the tubs, where they washed them in a solution of nicotine sulphate (40 per cent black leaf, used in dipping sheep) 1:1,000 dilution in alkaline water kept at a temperature of 100° F. or above, following which the articles were allowed to dry. The applicants' heads were next thoroughly washed with a mixture of equal parts of kerosene and dilute acetic acid. The males who would submit had their hair cut. About 15 per cent permitted it. There were two bathing tents—one for men and one for women and small children—and a dressing tent for women. These tents were in charge of male and female attendants, respectively, the attendants being individuals immune to typhus. In the tents the clothes were completely removed, and each individual's clothing was placed in a separate sack. The sacks were then thrown out and taken by an attendant to the steam sterilizers. Shoes, belts, hats, and other articles damageable by heat were sprayed with a 1:500 nicotine sulphate solution.

The applicants next proceeded to the shower bath, where, under the supervision of the attendant, their heads and bodies were thoroughly washed in soap and water, the soap being prepared by boiling 1 part of soap chips in 4 parts of water and adding 2 parts of kerosene. The solution used in the bath consisted of 1 part of this mixture in 4 parts of warm water. Following this preliminary bath, the applicants were given an ordinary bath of soap and water. Rough towels were furnished. After completion of the bathing process, the bather was given a sheet in which to wrap himself until such time as his sterilized clothing was available.

Delousing stands were made at five places, accessible to the entire district except to the Indians of the Aneth district, which is in Utah and which is separated from the infected areas by the swift San Juan River, which prohibits free communication. This district was never infected. The infected areas were each deloused two or three times at intervals of approximately 20 days. The campaign was terminated on September 3, 1921, and no cases have been reported from these areas to date (January, 1922). The last case occurred on June 13, 1921.

There were 6,205 men, women, and children deloused during the campaign, exclusive of about 1,000 deloused by the provisional plan above mentioned. These figures do not take into consideration the considerable number of "repeaters" who voluntarily underwent repeated delousings, some even following from one station to another.

Protection of employees.—Three of the delousing attendants were immune. One-piece uniforms of louse-tight material were provided for employees, and instructions issued relative to bathing, the steaming of uniforms, clothing, etc. No cases developed among any of the employees.

EFFECTS OF THE CAMPAIGN.

Of scarcely less importance than the eradication of the disease among the Indians was the educational value of the campaign among the natives. At first they viewed bathing with suspicion and fear, but later they came to enjoy it and willingly brought their families and household belongings from 10 to 50 miles in order that they might be cleaned. Traders were selling large quantities of soap to the natives at the close of the campaign, whereas previously its use among the Indians was extremely limited.

The natives who had always passively accepted their body vermin as a natural and necessary evil—since they believed that lice come from inside the body by passing through the skin—learned methods by which they could at least get temporary relief from these pests, and many of them were voluntarily applying the lessons when the campaign was terminated. The effect of the general delousing of the districts upon vermin was most marked in the case of body lice, which were seldom found; whereas head lice were still quite widely prevalent in the deloused areas at the close of the campaign, owing to the hatching of new crops, the nits not having been killed.

EARLIER EPIDEMIC.

A small epidemic of typhus occurred among the Navajos in 1914 at Cononcito, with 27 cases and 4 deaths. Prompt and vigorous measures checked the disease.

KNOWLEDGE GAINED FROM THE EPIDEMIC.

1. The Navajo Indian Reservation must be considered a potential focus of typhus fever and will remain such as long as the native inhabitants are permitted to live in their present vermin-infested condition.
2. Indians enjoy being clean and free of vermin, and if bathing and laundry facilities should be instituted at a few points where water is available, it is believed the Indians would avail themselves of the advantages. They repeatedly requested that this arrangement be made. Recommendations covering this point were made to the Department of the Interior by Dr. Newberne.
3. Medical men and Government employees upon the reservations should keep typhus fever constantly in mind as a possiblity in every case of illness.
4. Although it was found necessary to make a number of concessions regarding isolation and quarantine of cases and exposures in order to gain the cooperation of the natives, vigorous delousing measures brought the epidemic quickly under control.

Acknowledgments.—Personally and in behalf of the United States Public Health Service, the writer wishes to express his appreciation of the hearty and continued cooperation rendered by the Office of Indian Affairs and its chief medical supervisor, Dr. R. E. L. Newberne, in suppressing the outbreak; also to Dr. N. D. Frazin, of Tyrone, N. Mex., who assisted in the work during the month of July, for his faithful and efficient aid.

LIMITATIONS TO THE USE OF QUININE INTRAVENOUSLY IN THE TREATMENT OF MALARIA.[1]

By Kenneth F. Maxcy, Assistant Surgeon, United States Public Health Service.

Recently, along with the growing popularity of intravenous medication of various sorts, the intravenous injection of quinine has become a more common and widely used procedure in the treatment of malaria than formerly. *A priori*, the method appeals to one as being rational. It affords the opportunity of introducing the drug in known concentration directly into the blood stream in which the parasites are living. Theoretically it is the most exact and most effective mode of approach in the chemotherapy of malaria.

From the practical point of view, on the other hand, ever since the method was first advocated by Bacelli[2] it has been apparent to those who had large experience with the method that there were certain limitations to its field of usefulness. Without attempting a chronological review of the literature on the subject, it is the purpose of this paper to call attention again to certain dangers in the procedure and the precautions necessary in its use, with a view toward defining anew its proper field.

In judging the value of a method of treatment of malaria it is important to bear in mind that two objects are to be accomplished: First, the patient must be relieved of his acute attack; second, the parasites in his body must be damaged or destroyed to a degree that renders a relapse unlikely. While it is relatively easy to obtain data regarding the first requirement, it is rarely possible to follow up a sufficiently large series of treated cases over a sufficiently long period (at least six months and preferably a year or more) to establish the second point.

In this report attention is confined to the use of intravenous injection of quinine in the cure of the acute attack. The second point, i. e., the prevention of relapse, has been covered quite satisfactorily in recent war literature dealing with the treatment of thousands of cases

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[1] From Field Investigations of Malaria, United States Public Health Service.

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[2] Bacelli: Gaz. degli. Osped., Feb. 1890. Riform med. 1890, *6*.